March 1978

ELECTROMAGNETIC REPELLERS—FACT OR FICTION?

William D. Fitzwater

bioLOGIC consultants, 3919 Alta Monte NE, Albuquerque, New Mexico

ELECTROMAGNETIC REPELLERS—FACT OR FICTION?

WILLIAM D. FITZWATER, Director, bioLOGIC consultants, 3919 Alta Monte NE, Albuquerque, New Mexico 87110

ABSTRACT: The effectiveness of devices that supposedly repel a large number of invertebrate and vertebrate animals by emitting oscillating electromagnetic impulses is investigated. While scientific support that electromagnetic forces affect biological systems exists, these data are based on animals confined under higher intensity fields than are seemingly produced by commercial units. A number of instances of field use of the devices is discussed. These indicate little objective support for the units.

Mankind has become more sophisticated since the Pied Piper enthralled audiences of kids and rats. However, the feat of walking on the moon has again lent credibility to magic flutes. Devices that can be stuck in the ground and plugged into an electrical circuit to drive away rats, gophers, and other animals by electromagnetic impulses are not considered as far out as they might have been a few decades ago.

We have known about magnets for many years. Twenty-five hundred years ago, a Greek shepherd by the name of Magnes was supposed to have found his iron crook getting cluttered up with bits of rock. This natural iron ore became known as loadstone or magnetite (Efron, 1963). Basically, magnetism refers to lines of energy that flow between two poles. This energy can also be formed by electrical currents. Natural magnetic impulses are weak--a maximum of 0.5 gauss (G) (a measure of magnetic density) in the mid-latitutdes. Man-made magentism can range from 0.01 to 200 G (Sheppard and Eisenbud, 1977).

Interest in the application of electromagnetic principles probably started with the U.S. Navy's attempt in the sixties to set up an unjammable communication system using extremely low frequencies (ELF) from a transmitter station in northern Wisconsin (Brown, 1969). This project ("Sanguine" now being revived as "Seafarer" in upper Michigan) was shot down on environmental considerations but did interest some people in the possibility of using ELF to disrupt animal behavior.

Then in 1972 according to news reports (Anonymous, 1977), Bob Brown of Pine Valley, California, reportedly found dozens of dead rats and mice sprawled around his workshop. He had forgotten to turn off a miswired electric guitar he had been working on (I keep telling my kids those things are dangerous to your health!). From this he devised an apparatus he called the AMIG0™--an acronym for ants, mice, and pocket gophers.

Most of the units sold today are a spinoff from this device. They are buried in the ground to various depths and need an AC-110 volt power supply, except for NATURE SHIELD™ which operates on four small storage batteries. These units emit oscillating electromagnetic impulses that supposedly disorient the animals, upsetting their normal behavioral patterns. Claims are made they cover an effective area of about 200 meters or 10 hectares. However, topography and other environmental factors undoubtedly affect the range of any particular device. The units cost between $200 to $1200, so they aren't inexpensive.

The claims made for them by the salespeople are quite startling. They are able to eliminate problems with aphids, ants, cockroaches, darkling beetles, snails, spider mites, and thrips. The list of "susceptible" vertebrates is even more impressive--chipmunks, coyotes, foxes, ground squirrels, mice, mountain beavers, opossums, pocket gophers, prairie dogs, rabbits, rats, snakes, and voles.

Salespeople claim the devices have no effect on domesticated animals, including man. Some say this is because the sodium level is higher (making for higher conductivity) in wild animals than in domesticated ones. Others feel wild animals are more "hyped up". Endocrine imbalances in various parts of the body make their systems more susceptible to upset by magnetic forces.

So how do these devices work in the field? Supposedly, there is an increased amount of activity for about 2-3 days. After this, comatose, bewildered animals are found above ground. These exhibit a reluctance to re-enter ground burrows. Activity is supposed to cease in several weeks. The animals either move out of the field or die of starvation.

In search for scientific support of the above claims, the writer found many conflicting theories and experimental studies in this young science of electromagnetics. Jeno Barnothy (1964) states the effects of electromagnetic fields are: (1) sensory (effect on migrating bird movements [Larkin and Sutherland, 1977; Southern, 1973]), (2) stress (effect on the central nervous and endrocrine systems [Barnothy and Sumegi, 1969; Becker, 1969; Marino, et al., 1976]), or (3) genetic (retardation of aging [Ossenkopp, 1972]).

Of most importance in evaluating the effectiveness of electromagnetic repellers is (2) the stress effect. Here there is proof in experimental studies that electromagnetic fields do have a measurable influence on subject animals (Hanneman, 1969; Russell and Hedrick, 1969). Sheppard and Eisenbud (ibid) in a good review of electromagnetic effects on biological systems conclude "...relatively weak electric or magnetic fields are capable of evoking neurophysiological or behavioral effects." But while physicists seem in accord a potential exists, it does not seem the effects could be as severe as those reported by user testimonials of electromagnetic units.

Another factor is the intensity of electromagnetic fields. Russian studies showed behavioral changes in rats subjected to a 200 G magnetic field, but Sheppard and Eisenbud (ibid) state it is uncertain these effects are relevant at much lower field strengths. Persinger, et al. (1973) on the other hand feel that even at low intensities, ELF waves can propagate long distances without appreciable attenuation and even penetrate housing structures. They state this energy, theoretically at least, can contribute to neuroenergetic functioning and protein-lipid activity.

It is difficult to find data on the actual intensity of commercial electromagnetic repellers. Caslick, et al. (1977) report a unit (tradename?) they tested as not being greater than the normal power grid for New York State at 5 meters from the machine. An examination of NATURE SHIELD^{tm} with very sensitive equipment could not detect any measurable magnetic output from that unit (L. Dolphin, Stanford Research Inst., letter 2 Jun 77).

From the foregoing studies it seems magnetic forces can affect biological chemistry to the extent of altering physiological and possibly psychological patterns. But in these studies the animals were confined and subjected to extremely high magnetic impulses. In fact the magnetism emitted by some household appliances and commercial installations is probably more than the electromagnetic devices. can produce. But the final analysis lies in the record of these devices in the field.

There have been many favorable testimonials but little support by sound biological studies. Following is a series of case histories that have come to the attention of the writer:

(1) Cargill (a nation-wide grain processing company) reportedly had such good success with an installation of NATURE SHIELD^{tm} units at Terra Haute, Louisiana, they bought sixty of them to use in mills around the country. Members of the grounds crew at the Houston, Texas, installation stated signs of rat activity decreased around one unit installed in open land on the mill property. However, three other units installed later seemed to have no effect. When the first unit was moved to another area near the wharf, workers reported rat activity slowed down but in three to four weeks started back up again. It was also mentioned that a professional pest control company continues to carry on a weekly extermination program with gases and other toxicants.

(2) Ms Madglean Bush, Executive Director, Martin Luther King, Jr., Community Center (Houston, Texas) reported the installation of 17 NATURE SHIELDtm $_{un}$its in a 5 kilometer radius. She felt while the units hadn't completely solved the problem, they had done some good, but no objective data was offered.

Also in Houston, the City Rodent Control Section investigated a field test of a MAGNA-PULSE^{tm} device in an urban block (W.B. Jackson letter 21 Feb 78). After 43 days, inspectors trapped rats in the area and reported no apparent effect on rat numbers or activity.

(3) Jerome Stehly's ranch (Valley Center, California) was visited. He maintained, as reported in a magazine article (Anonymous, 1975), that thousands of mice had disappeared from the ranch and not returned after an AMIGO^{tm} unit had been installed. Unfortunately, there was no time to make a field check of his current situation. Another unit had been installed in a grove to reduce snail damage to citrus foliage. Examination of this unit, which was sunk in an irrigation tile, showed 3 to 4 live snails on the unit.

(4) The manager of a large egg processing plant in Griffin, Georgia, installed an AMIGO^{tm} unit three years ago to take care of a rat problem. It was so successful they purchased two more units. However, he admitted the rats were starting to come back into the plant. He advanced the theory these had been dry years and possibly the machines were not effective in dry situations.

(5) Gene Meester (PRESTO-X-COMPANY, Omaha, Nebraska) reported a NATURE SHIELD^{tm} was installed in a concrete basement of a seed storage building after they were unable to trap out all the mice. Mouse activity was noted on over 50 percent of the tracking patches laid down after the machine had been in place 2 weeks. At three weeks, 73 percent of the tracking patches showed mouse activity including those close to the machine.

(6) Big State Pest Control (Houston, Texas) personnel reported they knew of grain mills (K.E. Farmer's and West Texas) having electromagnetic units taken out after two months because they were ineffective. Permanent concrete bait stations on Continental milling company property were dusted with flour and baited with sardines and grain over a weekend. One was within 1 meter and the other about 5 meters from a NATURE SHIELD^{tm}. The bait stations were tracked up and most of the bait gone when the stations were checked. The company had these devices removed.

(7) Dr. Harry D. Muller, Extension Poultry Specialist, University of Georgia, had done considerable work in the field with these units and has the best success to date. An abstract of his paper to be published later (1978) reports the devices initially evoke increased activity such as burrowing, followed by atypical behavior including distorted diet patterns, burrow avoidance, lethargy, reduced reproduction, anorexia, and hypo-activity resulting in death. The mode of action is believed to involve an induced neurological dysfunction manifested by reduced reaction time and weakness. Recovery was noted when the magnetic field was interrupted or withdrawn.

(8) In a New York study (Caslick, et al., ibid), mice were trapped, marked, and released in a poultry house before a unit (tradename?) was installed:

Date	No. Mice Caught	No. Marked Mice Retrapped
Aug 2	80	--
Aug 3	Device installed	--
Aug 10	67	8
Aug 26	53	3

Unfortunately, a rodent-baiting program was continued during the test period. Thus a number of dead mice were found in the building during the study. They concluded the mouse population remained heavy throughout the 24-day test period going no lower than 65 percent of the pre-test population. Furthermore, on the final trap date, two adult marked females were recaptured indicating reproductive processes had not ceased during the operation of the electromagnetic device.

(9) Dr. W.F. Kruger (Poultry Science Department, Texas A&M University) in 1975 installed an AMIGO[tm] in a poultry house. The test had to be terminated because the rat population remained so great. The device was used again in 1976 but this time the rodent levels were so low (due to other causes) no definite conclusions could be drawn.

(10) Rooney and McKeen (1977) ran a study with AMIGO[tm] units on a large egg ranch in San Bernardino, California. Censuses were made on the basis of mouse consumption of paraffin-feed blocks. They found no significant influence on the populations when the units were put in use. Simultaneous studies made with caged mice showed no significant differences in survival rates.

(11) Steve Palmateer, EPA Animal Biology Laboratory, Beltsville, Maryland, wrote (letter 25 Aug 77): "...we tested feeding, eating, and breeding success of rats both within the claimed area of effect and in a control area about two miles away. There was very little difference in activity between the test and control groups of rats."

(12) James F. Glahn, U.S. Fish and Wildlife Service, Fresno, California (letter 25 Jan 77) studied the effect of a NATURE SHIELD[tm] unit on a ground squirrel colony in California. Activity was determined by closing burrow openings. They found an insignificant reduction in activity over a month's period.

(13) James F. Glahn, U.S. Fish and Wildlife Service, Fresno, California, (letter 18 Mar 77) ran another test of NATURE SHIELD[tm] devices in which California pocket gopher mounds were flattened and checked within a 48-hour period. There was no significant difference in gopher activity after 42 days of treatment.

(14) Howard Tietjen, U.S. Fish and Wildlife Service, Denver, Colorado, (letter 14 Jun 77) reported experiments with NATURE SHIELD[tm] unit in Colorado against ground squirrels (Spermophilus richardsoni) showed no effects on normal rodent behavior.

(15) The AMIGO[tm] device reportedly had no effect on activity or body weight of the plains pocket gopher (Geomys bursarius) in Nebraska (Case, et al., 1977). They determined gopher activity by opening holes and checking back in 24 hours on both control and test areas over a four-week period.

(16) Bill B. Gillespie (personal conversation and letters) has reported a study at Camp Pendleton, California. AMIGO[tm] units were established in early 1976 on an irrigated parade ground that had a gopher (Thomomys bottae) problem. Figure 1 shows gopher activity based on flattening mounds and counting the number that were active on the following week. Unfortunately, no controls were maintained in an area outside the range of the devices. During the early part of the study, there appeared to be a correlation in the increase of activity during periods the machine(s) were inoperative. However, when the AMIGO[tm] was replaced by SIGMA[tm] and later ALPHA[tm] units, activity climbed to new heights and remained there even when AMIGO[tm] units were installed again.

CONCLUSIONS

There appears to exist a scientific basis for the belief that electromagnetic forces can change behavioral patterns of mammals. However, experimental support data are based on animals confined in higher intensity fields than seem possible with field units.

While the machines may work, the large percentage of failures suggests they will work only under narrow parameters of topography, soil moisture, and other, as yet undetermined, environmental factors.

A large stumbling block in the way of their acceptance is the poor engineering design of current commercial models. They may break down soon after being installed or some are inoperative from the start. It is difficult to measure magnetic force to ascertain if the machines are in fact operating satisfactorily. There is a decided difference between potential effectiveness of devices made by different manufacturers, but reports tend to treat them all as similar devices.

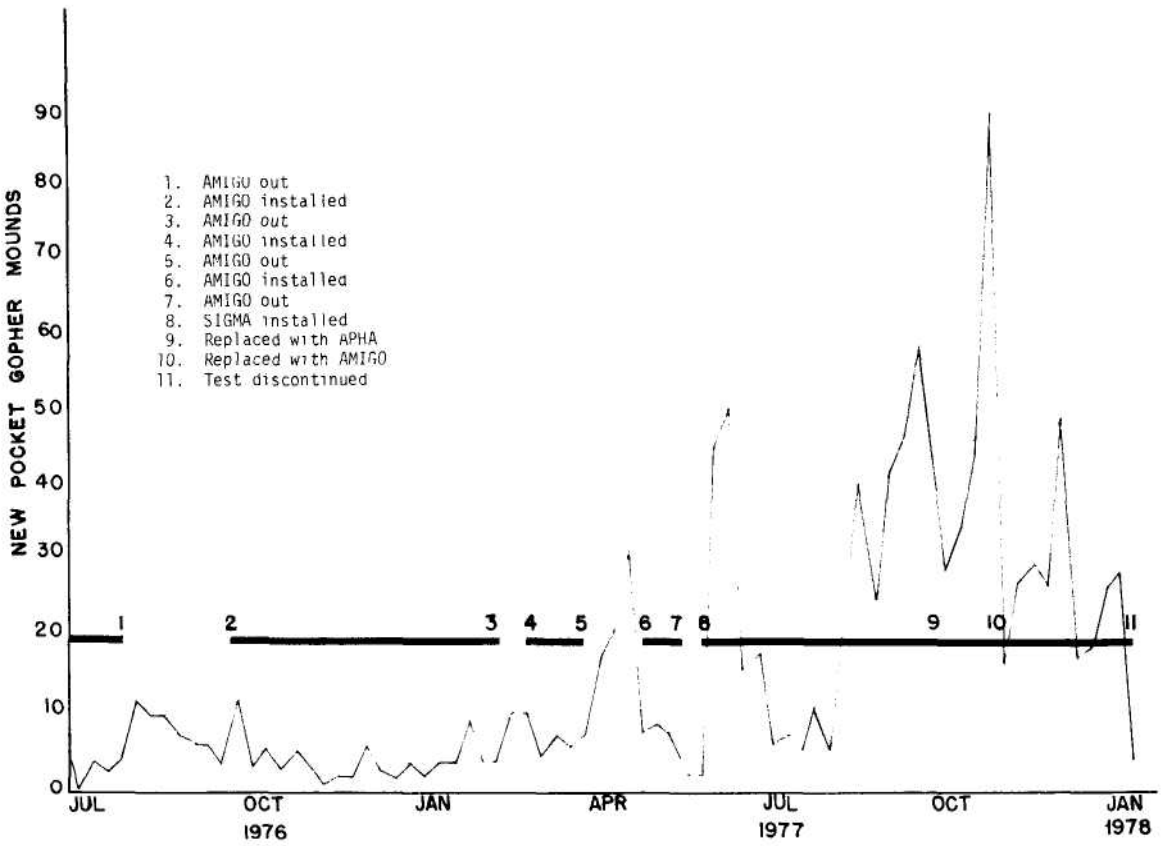

Figure 1. Effect of electromagnetics on pocket gophers at Camp Pendleton, California (B.B. Gillespie).

Reliance on user testimonials rather than objective biological data is questionable. Despite the apparent sincerity of individuals, the question arises on the validity of subjective observations by persons lacking an understanding of rodent habits plus emotional influences of a desire to please the questioner with the answer he wants to hear or a reluctance to admit an error in judgment. It is unfortunate developers of the devices have concentrated efforts on high pressure salesmanship rather than documenting sound supporting data.

The final question on practicality of the devices hinges on their reported effectiveness. In practically every case, even those who feel the units work, the units weren't completely successful and must be supplemented with other rodent control measures. There also seems to be a loss of effectiveness in the same area over a period of time. As the price of one of these units will buy a considerable amount of rodentproofing construction and big bags of poison bait, their economic practicality can be seriously questioned.

MANUFACTURERS OF ELECTROMAGNETIC DEVICES*

	Trade Name of Devices
Bell Products Corp., 4620 Cecelia, Bell, CA 90201	MAGNA PULSE
Mira Manufacturing Company, Route 1, Box 24, Boulevard, CA 92005	AMIGO, ERGON, TERRA-TROL
Orgolini Manufacturing Company, Inc., 260 Freeport Blvd., Sparks, NV 89431	SIGMA, ALPHA
Solara Electronics, Inc., 1591 Sunland Lane, Costa Mesa, CA 92626	NATURE SHIELD

*This listing includes all companies the writer is aware of at this writing.

LITERATURE CITED

ANONYMOUS. 1975. Electromagnetic energy drives mice away. Poultry Digest. Dec.

ANONYMOUS. 1977. Ole, Amigo! Time. 110(9):32.

BARNOTHY, JENO M. 1964. Introduction. In M.F. Barnothy (ed). Biological effects of magnetic fields. Plenum Press, (New York), pp 1-24.

BARNOTHY, M.F., and I. SUMEGI. 1969. Effects of the magnetic field on internal organs and the endrocrine system of mice. In M.F. Barnothy (ed). Biological effects of magnetic fields. Vol. 2. Plenum Press, (New York). pp 103-126.

BECKER, ROBERT 0. 1969. The effect of magnetic fields upon the central nervous system. In M.F. Barnothy (ed). Biological effects of magnetic fields. Vol. 2. Plenum Press, (New York). pp. 207-214.

BROWN, KEVIN V. 1969. How we'll broadcast with "mystery" radio waves. Popular Science Monthly 195(3):104-107, 210.

CASE, RONALD M., WILLIAM F. ANDELT, and DALE G. LUCE. 1977. Field evaluation of an electro-magnetic device for pocket gopher control. Dept. Forest., Fish. & Wildl., Univ. Nebraska. 2 pp. mimeo.

CASLICK, JAMES W., CHARLES E. OSTRANDER, and L. DALE BAKER. 1977. Effectiveness of an electromagnetic device in controlling house mice (Mus musculus). NYSC of Agric. and Life Sci., Natural Resources and Extension Series (Cornell Univ.) No. 9. 4pp.

EFRON, ALEXANDER. 1969. Magnets and magnetic properties of matter. In Collier's Encyclopedia (Crowell-Collier Publ. Co.), 15:209-217.

HANNEMAN, G.D. 1969. Change in sodium and potassium content of urine from mice subjected to intense magnetic fields. In M.F. Barnothy (ed). Biological effects of magnetic fields. Vol. 2. Plenum Press (New York). pp 127-135.

LARKIN, RONALD P., and PAMELA J. SUTHERLAND. 1977. Migrating birds respond to project Seafarer's electromagnetic field. Science 195:777-779.

MARION, ANDREW A., THOMAS J. BERGER, B. PETER AUSTIN, ROBERT 0. BECKER, and FRANCIS X. HART. 1976. Evaluation of electrochemical information transfer system. 1. Effect of electric fields on living organisms. J. Electrochem. Soc. 123(8):1199-1200.

MULLER, HARRY D. 1978. Electromagnetic rodent control - for poultry facilities. Southern Assoc. Agric. Scientists - Poultry Section. unpubl. abstract.

OSSENKOPP, KLAUS-PETER. 1972. Maturation and open-field behavior in rats exposed prenatally to an ELF low-intensity rotating magnetic field. Psychological Repts. 30:371-374.

PERSINGER, M.A., H.W. LUDWIG, and K-P. OSSENKOPP. 1973. Psychophysiological effects of extremely low frequency electromagnetic fields: a review. Perception & Motor Skills 36:1131-1159.

ROONEY, W.F., and W.D. MC KEEN. 1977. A study of rodent repellers for house mouse control. Progress in Poultry (UC-Coop.Ext.) No. 10. 6pp.

RUSSELL, D.R., and H.G. HEDRICK. 1969. Preference of mice to consume food and water in an environment with high magnetic field. In M.F. Barnothy (ed). Biological effects of magnetic fields. Vol. 2. Plenum Press, (New York). pp 223-239.

SHEPPHARD, ASHER R., and MERRIL EISENBUD. 1977. Biological effects of electric and magnetic fields of extremely low frequency. NYU Press, (New York). 225 pp.

SOUTHERN, WILLIAM E. 1973. Orientation behavior of ring-billed gull chicks (Larus delawarensis) exposed to project Sanguine's electric and magnetic fields. Prog. Rept. 15 Sep 73, U.S. Navy, Office of Naval Res., mimeo, 32 pp.